

VII. *The condition of the scales in the leaden males of Agriades thetis, Rott., and in other Lycaenids.* By E. A. COCKAYNE, D.M., F.R.C.P., Temporary Surgeon, R.N.

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PLATE XI.

THE peculiar colour of the leaden males of *Agriades thetis*, many of which were taken near Folkestone in 1916 and occasional specimens in previous years, led me to think that a microscopical examination of their scales might be of considerable interest.

In the normal male *thetis* the wing is covered with lines of smoky scales, short and broad, which have strong longitudinal ribs and well-marked cross striations. Alternating with the rows of dark scales are rows of longer scales, which I call for convenience the "colour scales." These are also longitudinally ribbed, but have weaker cross striation, and are yellow by transmitted light and brilliant blue by reflected light. The blue colour has generally been regarded as an interference colour due to the cross striae and not a pigmentary colour, but H. M. Sims (Canadian Entomologist, 1915, p. 161) considers that it is dependent on a fluorescent dye. In either case the dark scales serve to absorb any light which passes through the blue scales, and to prevent the coloured scales on the underside of the wing from being visible on the upperside.

In addition to these two kinds of scales small colourless androconial scales are present in abundance. In the leaden males of *thetis*, the smoky scales and androconia are of normal shape, size and colour, but all the colour scales are very thin, and have their distal part rolled up to form a tube. By reflected light the curled-up edges and tubular ends of these scales look silvery, and under a low power of the microscope appear as ghostly triangles overlying the dark scales, which are much exposed to direct view and give the leaden colour to the wings.

Examined under a high power ( $\frac{1}{2}$  inch oil immersion) it is seen that they are quite colourless by transmitted light. The longitudinal ribs are present, though often crinkled, but no cross striae are present with the exception of a few imperfect ones at the extreme base of the scales.

A few scales were found in which the lateral margins were turned up, and in which very pale yellow dye was present, but no cross striation. Unfortunately they were mounted in balsam, and I could not see whether they were blue by reflected light. If a scale of this nature could be isolated and examined unmounted it would settle the controversy as to the cause of the blue colour in the blue Lycaenids.

Near the base of all four wings in both the specimens examined, and along the costal margin of the right forewing in one of them, normal thick blue scales were found with the abnormal ones.

Some of the scales on the fringes were thinner and more hair-like than is usual, but the scales on the undersides of the wings were all quite normal. The peculiarity can scarcely be due to any pathological condition acting upon the scales from without. If this were so the neighbouring dark scales and androconia would not escape, nor would the scales of the underside be perfect.

No injury, nor any infection by a pathogenic organism, would be likely to affect the upper surfaces of all four wings in the uniform and complete way in which it is almost always affected in these leaden *thetis*. It is much more likely to be dependent on some inborn error of development.

The following observations of Mr. G. T. Bethune-Baker lend strong support to this view. According to this author the blue scales in *Polyommatus dolus* var. *vittata* are very similar to the abnormal scales of the aberration of *thetis*. I quote the description of these in his Presidential Address (Proc. Ent. Soc. 1913, p. clviii): "An extraordinary character, however, obtains in the ordinary blue wing scales, the whole of which are curled round so as to form more or less short tubes; the process appears to be that each side of the scales turns over, and occasionally they meet thus in the centre, but more generally one side will overlap the other and so form a more or less perfect tube; by this I mean that the basal

and apical ends remain open—a tube that is sealed at each end naturally ceases to be a tube, becoming a cylinder.”

This description agrees very closely with the condition met with in the “colour scales” of the leaden *thetis*, but in *dolus* the tubular scales are blue and presumably retain their cross striation or the fluorescent dye. Similar rolled-up scales have been described by Mr. Bethune-Baker in the “*Menalca*” group, in which the wing colour is much whiter than in most *Lycaenids*.

I wrote to Mr. Bethune-Baker, who has examined microscopically several leaden aberrations in his collection, and has very kindly allowed me to publish his notes on the condition of the scales in them. He has examined one *Lycaena arion*, one *Polyommatus icarus*, two *Lycaenopsis (Celastrina) puspa*, two *Lycaenopsis planta*, and a single specimen each of three species of *Tajuria*, an exotic genus.

In the *arion*, which is a dull bluish colour, the scales are only curled up in a small percentage, in the majority being merely thin and inclined to buckle at the edges. In the *icarus*, which is greyer though not extremely leaden coloured, the scales are thinner and more curled than in the *arion*.

In all three species of *Tajuria*, which are much more leaden coloured, the scales are rolled upwards and inwards at the sides, the rolling being deeper at the apices, so that in many they have a triangular shape. The rolled-up scales are abnormally thin. This thinness is readily demonstrated in one *Tajuria*, which has one or two spots of blue on the wings, where the scales are flat, normal in colour and of much greater density.

The two specimens of *Lycaenopsis puspa* from Formosa show much the same condition as the *Tajuria*. The two *L. planta* from Borneo are quite unusually leaden coloured. Under an inch objective the “colour scales” are almost invisible, but under a 12 mm. objective are seen to be excessively thin and rolled up absolutely tight, so tight as to look like a number of short thick pale hairs scattered over the surface of the wings. The fringes are also abnormal, the usual long, elegant, somewhat fan-shaped scales being replaced by scales like long thin hairs with the apex slightly split up.

Breeding experiments with leaden *thetis* would be very interesting. These leaden aberrations, so widespread

through the blue Lycaenids, may well be Mendelian recessives to the normal blue males. The "dolus" and "menalcas" group may be examples of Mendelian recessives superseding the normal dominants through whole species, as the recessive form of *Callimorpha dominula* with yellow hind-wings has entirely replaced the dominant with red hind-wings in certain parts of Italy. This suggestion is one put forward in order that some one may take the necessary steps to prove or disprove it.

A further point of interest in connection with the leaden *thetis* is that Mr. L. W. Newman thinks that they are unusually fragile. It is quite possible that the whole wing membrane is thinner than that of normal males, and, if so, it may be correlated with the thinness of the "colour scales." I have not been able to satisfy myself on the point, as I did not wish to destroy a specimen for this purpose.

#### EXPLANATION OF PLATE XI.

1. "Colour" scales of leaden male *Agriades thetis*.
2. Blue "colour" scale of normal male *Agriades thetis*.
3. Smoky (light absorbing) scale of leaden male *Agriades thetis*.
4. Androconial scale of leaden male *Agriades thetis*.

The fine regular striae of the blue scale are only roughly indicated. The drawings are magnified equally.